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## Calfoams

### Alkyl Sulfates

SLS-30 (Sodium lauryl Sulfate)  
ALS-30 (Ammonium lauryl Sulfate)

### Alkyl Ether Sulfates

ES-302 (Sodium Lauryl Ether Sulfate 2 mole EO)  
ES-303 (Sodium Lauryl Ether Sulfate 3 mole EO)  
ES-603 (Sodium Lauryl Ether Sulfate 3 mole EO)  
ES-702 (Sodium Lauryl Ether Sulfate 2 mole EO)  
ES-703 (Sodium Lauryl Ether Sulfate 3 mole EO)  
EA-303 (Ammonium Lauryl Ether Sulfate 3 mole EO)  
EA-703 (Ammonium Lauryl Ether Sulfate 3 mole EO)

### Nomenclature and just a little bit of Chemistry:

All surfactants have two parts, an oil loving (or oil soluble) part called hydrophobe and a water loving (or water soluble) part called hydrophile. A long carbon chain derived from a fatty source like coconut oil makes the hydrophobe part of Calfoam<sup>®</sup> surfactants. We call it alkyl chain. The sulfate group makes the hydrophilic part of the Calfoams<sup>®</sup>. Thus the chemical name alkyl sulfate. People also call them alcohol sulfates. All Calfoams<sup>®</sup> are derived from natural, vegetable, renewable resources (mainly coconut oil). They are also biodegradable.

When Calfoams<sup>®</sup> are manufactured they come out in acid form. The acid is then neutralized with an alkali to make the final Calfoam<sup>®</sup> product as we market. Because of cost / performance two alkalis, sodium hydroxide and ammonium hydroxide, are commonly used to neutralize the acid form of Calfoam<sup>®</sup> products to give sodium and ammonium salts respectively. The only difference between SLS-30 and ALS-30 is that SLS-30 is sodium salt whereas the ALS-30 is the ammonium salt. So the nomenclature for these two products is as follows:

S	Sodium
A	Ammonium
L	Lauryl
Last S	Sulfate
30	% Active

% active means how much of the actual surfactant is in the product. Another term used commonly is % solids. Many surfactants also contain salts such as sodium chloride and sodium sulfate present. These salts along with other non surfactant components are generally included in the % solids of the product. In other words, if we subtract the amount of solvent like water, alcohol, etc. from 100, we will get the % solid of the product. An easy test for determining the % solids is to take the material as is and heat it at 105 C for two hours. The difference between the weight before and after will give the amount of solvent, and if this number is subtracted from 100, it will give the % solid number.

### Why some formulators use SLS-30 and others will use ALS-30:

The two products are quite similar and both are widely used in personal cleansers like shampoos, body washes, hand soaps, etc. ALS-30 has a little better lather profile and flash foaming. It has a lower cloud point (clouds at a lower temp. than SLS-30) and has slightly better viscosity building characteristics. On the negative side, it will release ammonia at higher pH. Some formulators think that this ammonia releasing risk is not worth taking for slightly higher viscosity and foam.

Most formulators use sodium lauryl ether sulfates (like our ES-302) in conjunction with SLS-30 in order to formulate a personal cleanser. Occasionally you will find a product on the market that is based on only SLS-30-type surfactant. A very simple and economical formula for a shampoo can be:

Water	to 100%
Calfoam <sup>®</sup> SLS-30	30.0
Calamide <sup>®</sup> C	3.0
Sodium chloride	3.0
Preservative, perfume, dye	Q.S

Most formulators would add 3-10% Caltaine<sup>®</sup> C-35 to this formula for mildness since SLS-30 is quite irritating to the skin.

Besides personal cleansers SLS-30 and ALS-30 are also used in:

- Hand dish wash detergent
- Pet shampoos
- Pot and pan cleaners
- Car wash soaps
- Emulsion polymerization
- Tooth paste (SLS in powder form)
- Kids bubble maker
- Fruit and vegetable cleaners (SLS only)
- Liquid laundry detergents

Now that the market is going more and more toward "natural," some formulators of specialty cleaners are looking to replace LAS and AOS with SLS, since it is derived from natural coconut feed stock.

### Why Ether Sulfates???

Curious mind will ask the question, when we have these nice good foaming, good viscosity building surfactants like SLS-30 and ALS-30, why do we need ether sulfates like sodium lauryl ether sulfate (like our Calfoam<sup>®</sup> ES-302) and ammonium lauryl ether sulfate (like Calfoam<sup>®</sup> EA-303)?

Let's first talk about the nomenclature and a little tiny bit of chemistry here again. If we take SLS-30 and somehow insert ethylene oxide into it, it will become SLES or sodium lauryl ether sulfate. This product can be called by several names. As a class of surfactants they can be called:

Ether sulfates	or
Alkyl ether sulfate	or
Alcohol ether sulfate	or
Laureth sulfate	or just like SLS (sodium lauryl sulfate) the sodium salt is called SLES

Let's talk a little about what ethylene oxide (EO) IS, and what it does when we add it to SLS to make it into SLES, and more importantly why? Earlier we discussed the hydrophilic and hydrophobic parts of a surfactant molecule. SLS is a good high-foaming surfactant but it lacks the solubility, flash foam, viscosity and rheology characteristics required in many personal care products. The addition of EO improves these properties. That is why SLS or ALS was modified to SLES and ALES, respectively by adding EO to them. Another aspect of this is how much EO should be added. This is expressed in the number of moles. Moles are just molecular weight expressed in grams. So if we take the one molar weight of SLS and add one molar weight of EO, we can say the resulting product will be SLES one mole. If we add twice the molar weight of EO to one molar weight of SLS then it will be SLES 2 mole and so on.

Most anionic surfactants like Calfoam<sup>®</sup> and Calsofts<sup>®</sup> have limited solubility in water. Most Calfoams<sup>®</sup>, particularly the ether sulfates, for example can be made as 30% active aqueous solutions. By adding ethyl alcohol, the activity can be raised to 60%. The solubility curve also allows these ether sulfates to be made as 70% active flowing gels. Hence the ether sulfates are offered in three activity grades namely 30%, 60% and 70%. Pilot's ether sulfate nomenclature is as follows.

S	sodium
A	ammonium
E	EO
123	(the three digits at the end)
	First two digits=Activity
	Last digit= No. of moles of EO

For example in Calfoam<sup>®</sup> ES-302 we know that it is an ether sulfate (E). It is sodium salt (S). It is about 30% active (27%) and has 2 moles of EO. Can you do the same for Calfoam<sup>®</sup> EA-703?

As we increase the moles of EO from one to two to three, how does it impact the performance of the product? Generally speaking here is how:

- Increases solubility
- Increases mildness
- Increases flash foam
- Decreases foam stability
- Decreases viscosity building

These differences are not very prominent in most cases except for viscosity building; there is a significant difference between 2 mole and three mole. Two mole gives higher viscosity. In most applications formulators tend to use the 2 mole product like our Calfoam<sup>®</sup> ES-302.

The activity levels also impact the performance, handling and storage as well as the processing of the batch. From the performance standpoint, the 30 and 70% will behave similarly and the 60% will be a little different in viscosity building and after effects of the product. Because of the presence of alcohol in 60% material, it will not build as high a viscosity as the 30 or 70% materials will. The 60% will also require special storage facility that meets the regulations for storing flammable materials. The 60% material may be somewhat more drying to the skin (not much though), although the presence of alcohol will improve the antibacterial impact of the product and alcohol will also improve the low temperature stability and freeze thaw stability of the product.

30% (more accurately 26-28%) active products are the easiest for storage and handling. 60% active material, as we mentioned before, require special storage suitable for flammable materials. The 70% material also requires special handling and storage since this material has high viscosity and gets even higher at cold temperatures. The material requires special pumping equipment as well.

The 30% is once again the easiest to be processed when making a batch. It mixes with water fairly quickly where as the 60% takes a little time to disperse and the 70% active material takes even longer. On the plus side 70% is the most economical material on per lb. active basis.

## Our main competitors and their offsets

Pilot	Stepan	Noveon/ Lubrizol	Cognis	Witco/ Akzo	Rhodia
Calfoam <sup>®</sup> SLS-30	Stepanol WA-Extra	Sulfochem SLS	Standapol WAQ-special	Witconate WAQ	Rhodapon LX-28/AF3
Calfoam <sup>®</sup> ALS-30	Stepanol AM V	Sulfochem ALS	Standapol A	Witcolate NH	
Calfoam <sup>®</sup> ES-301	Steol CS-130	Sulfochem ES-1	Standapol ES-1		Rhodapex ESY STD
Calfoam <sup>®</sup> ES-302	Steol CS-230	Sulfochem ES-2	Standapol ES-2		Rhodapex ES-2 STD
Calfoam <sup>®</sup> ES-303	Steol CS-330	Sulfochem ES-3	Standapol ES-3		Rhodapex ESB-3/A2
Calfoam <sup>®</sup> ES-603	Steol CS-460	Sulfochem ES-60		Witcolate LES-60C	
Calfoam <sup>®</sup> ES-702	Steol CS-270	Sulfochem ES-70			Rhodapex ESB-70/A2
Calfoam <sup>®</sup> ES-703	Steol CS-370				Rhodapex ESC-70/AB
Calfoam <sup>®</sup> EA-303	Steol CA-330	Sulfochem EA-3			Rhodapex EA-2
Calfoam <sup>®</sup> EA-603	Steol CA-460	Sulfochem EA-60		Witcolate LES-60A	
Calfoam <sup>®</sup> EA-703	Steol CS-370				
Calfoam <sup>®</sup> TLS-40	Stepanol WAT	Sulfochem TLS	Standapol T	Witcolate TLS-500	Rhodapon TL-40/A

## Typical Physical Properties of Calfoam Products

	Actives/ Solids	Viscosity cPs	Density lb/gal	pH	Ross Miles Foam (mm) 0.1% act	Mol. Wt.
SLS-30	30	< 500	8.7	8.0	120	302
ALS-30	30	< 5000	8.4	6.5		294
ES-301	26	<500	8.7	8.0		346
ES-302	27	<500	8.7	8.0	150	390
ES-303	28	<500	8.9	7.5	150	429
ES-603	58	<500	8.7	8.0	145	441
ES-702	70			8.0	150	382
ES-703	70			8.0	150	429
EA-303	27	<5000	8.6	6.3	140	424
EA-603	58	<500	8.7	7.0	150	424
EA-703	70			6.2	140	424

Some general comments about recommending Calfoam<sup>®</sup> products for personal care and pet care applications like shampoo, body wash, liquid hand soap, pet shampoo.

The formula will be adjusted to pH 7 or higher, do not use Calfoam<sup>®</sup> ALS or Calfoam<sup>®</sup> EA

A mixture (50:50) of SLS-30 and ES-302 works better than just one of these products alone for foam, lather quality, after feel and viscosity as well as clarity and cloud point.

If the customer does not have special equipment for pumping high viscosity, gel type consistency then they should not use 70% active Calfoams<sup>®</sup> and stay with 30% active materials like ES-302 or EA-303

If the customer does not have storage capability for flammable materials then they should not use 60% active materials.

30% active Calfoams<sup>®</sup>, although higher in per pound active material cost, compared to 60% and 70% active Calfoams<sup>®</sup> but the 30% are the easiest as for as storage, handling and processing is concerned.

SLS-30 / ES-302 & ALS-30 / EA-302, 303 are common combination of primary surfactants that make the bulk of a personal or pet shampoo and other cleansing products.

A very basic, economic shampoo formula is a combination of SLS-30/ALS-30, EE-302/EA-303, Calamide<sup>®</sup> C / MC, Caltaine<sup>®</sup> C-35 and salt.

All Calfoam<sup>®</sup> products are based on natural, vegetable feed stock and are biodegradable.

Let us examine the formulation techniques and explore the applications where Calfoams<sup>®</sup> are the products of choice and provide cost/performance advantages to the formulator. Calfoams<sup>®</sup> are high foaming anionic surfactants used in a wide variety of personal care and H I & I applications. Almost any finished product that has a requirement for high copious foam can use Calfoams<sup>®</sup> as the primary surfactant raw material. Some applications where Calfoams<sup>®</sup> are used are listed below.

- Hair shampoo
- Body wash
- Liquid hand soap
- Manual dishwash detergent
- Car wash soap
- Laundry detergent
- Pet shampoo
- Bubble bath
- Children bubble maker
- Fine fabric wash
- Carpet shampoo
- Laundry prespotter
- Facial wash

Some starting formulations that will illustrate the use of Calfoam<sup>®</sup> anionic surfactants in various applications are listed below.

## **Neutral All Purpose Cleaner**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Sodium Citrate	2.5
Dowanol PnB	5.0
Calfoam® SLS-30	10.0
Calamide® CW-100	5.0
Preservatives, dye	Q.S
Citric Acid	to pH 7.0

Procedure: Add all ingredients in the order listed with constant mixing. Mix well after each ingredient has been added and then at the end after all ingredients have been added until the batch is clear, smooth, homogenous and free of lumps and particles.

## **Car Wash Presoak “Natural”, Biodegradable**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Sodium Citrate	10.0
Calfoam® ES-302	25.0
Preservative, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed with continuous mixing. Mix well after each ingredient has been added until the batch is clear. Mix after all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps or particles.

## **Car Wash Soap Non - Phosphate**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
TetrasodiumEDTA	4.0
Sodium metasilicate pentahydrate	2.0
Calsoft® AOS-40	40.0
Calamide® C	2.0
Sodium Citrate	2.0
Preservative, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed with continuous mixing. Mix well after each ingredient has been added until the batch is clear. Mix after all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps or particles.

## Car Wash Soap “Natural”, Biodegradable

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Calfoam <sup>®</sup> ES-302	50.0
Polysorbate 20	3.0
D'limonene	2.0
Preservative, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed with continuous mixing. Mix well after each ingredient has been added until the batch is clear. Mix after all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps or particles.

## Plastic and Vinyl Cleaner

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Sodium Citrate	3.0
Calfoam <sup>®</sup> ES-303	2.0
Dowanol DPM	5.0
Preservative, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed with continuous mixing. Mix well after each ingredient has been added until the batch is clear. Mix after all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps or particles.

## “Natural” Glass & Window Cleaner

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Ethyl alcohol	5.0
Calfoam <sup>®</sup> SLS-30	0.5
Sodium Citrate	0.1
Preservative, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed with continuous mixing. Mix well after each ingredient has been added until the batch is clear. Mix after all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps or particles.

## **“Natural” Hand Dishwashing Liquid**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Calfoam <sup>®</sup> SLS-30	25.0
Caltaine <sup>®</sup> C-35	5.0
Caloxamine <sup>®</sup> LO	10.0
Calamide <sup>®</sup> C	3.0
Sodium chloride	0.5
Preservatives, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed to a mixing tank with continuous agitation. Mix well after each ingredient has been added and then at the end until a clear, smooth, homogenous Batch results that is free of lumps or particles.

## **“Natural” and Mild Hand Dishwashing Liquid**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Calfoam <sup>®</sup> ES-303	35.0
Caltaine <sup>®</sup> C-35	15.0
Calamide <sup>®</sup> C	3.0
Sodium chloride	0.5
Preservatives, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed to a mixing tank with continuous agitation. Mix well after each ingredient has been added and then at the end until a clear, smooth, homogenous Batch results that is free of lumps or particles.

## **“Natural” Mild Hand Dishwashing Liquid With Moisturizers**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Glycerin	2.0
Aloe leaf extract	1.0
Calfoam <sup>®</sup> ES-303	35.0
Caltaine <sup>®</sup> C-35	15.0
Calamide <sup>®</sup> C	3.0
Sodium chloride	0.5
Preservatives, perfume, dye	Q.S

Procedure: Add all ingredients in the order listed to a mixing tank with continuous agitation. Mix well after each ingredient has been added and then at the end until a clear, smooth, homogenous batch results that is free of lumps or particles.

## **Economy Shampoo**

<b>Ingredient</b>	<b>% w/w</b>
Water	83.0
Calfoam <sup>®</sup> ES-702	10.0
Caltaine <sup>®</sup> C-35	3.0
Calamide <sup>®</sup> MC	1.0
Sodium Chloride	3.0
Preservative, perfume & dye	as required

Procedure: Heat water to 70<sup>0</sup> C. and maintain this temperature. Add all ingredients in the order listed with appropriate mixing. Mix well after each ingredient has been added until the batch is smooth, homogenous and is free of lumps or particles. Cool the batch down to 35<sup>0</sup> C. Add preservative, perfume & dye. Continue cooling to room temperature. Let stand the batch until the air is out before packaging it.

## **Foaming Liquid Soap for Foam Dispensers**

<b>Ingredients</b>	<b>% w/w</b>
Water	to 100%
Calfoam <sup>®</sup> ES-603	10.0
Caltaine <sup>®</sup> C-35.0	5.0
PEG-80 Sorbitan laurate	2.0
Preservatives, perfume & dye	Q.S

Procedure: Add all ingredients in the order listed with appropriate mixing. Mix well after each ingredient has been added until the batch is smooth, homogenous and is free of lumps or particles.

## **Lotion Hand Soap**

<b>Ingredients</b>	<b>% w/w</b>
Water	Q.S to 100%
Calfoam <sup>®</sup> SLS-30	8.7
Calfoam <sup>®</sup> ES-302	11.2
Caltaine <sup>®</sup> C-35	4.2
Calamide <sup>®</sup> MC	1.8
Sodium Chloride	2.7
Citric Acid	to pH 5.5
Preservative, dye, perfume	Q.S

Procedure: Add the first three ingredients in the order listed with constant mixing and heating until the batch gets to 70 C. Add Calamide<sup>®</sup> MC, mix and cool to room temp. Add the rest of the ingredients in the order listed. Mix well after each ingredient has been added and then at the end to ensure a clear, smooth and homogenous batch that is free of lumps or particles.

## Liquid Hand Soap for Foaming Dispensers

<b>Ingredients</b>	<b>% w/w</b>
Water	Q.S to 100%
Calfoam <sup>®</sup> ES-302	10.0
Calfoam <sup>®</sup> SLS-30	10.0
Caloxamine <sup>®</sup> LO	5.0
Caltaine <sup>®</sup> C-35	5.0
Preservative, dye, perfume	Q.S

Procedure: Add all ingredients in the order listed with constant mixing. Mix well after each ingredient has been added and then at the end to ensure a clear, smooth and homogenous batch that is free of lumps or particles.

## Body Wash for Foaming Dispensers

<b>Ingredient</b>	<b>% w/w</b>
Water	Q.S to 100%
Calfoam <sup>®</sup> ES-302	40.0
Caltaine <sup>®</sup> C-35	10.0
Glycerin	10.0
Preservative, dye, perfume	Q.S

Procedure: Add all ingredients in the order listed with constant mixing. Mix well after each ingredient has been added and then at the end to ensure a clear, smooth and homogenous batch that is free of lumps or particles.

## Amide Free, Hydrating Hand Cleanser

<b>Ingredient</b>	<b>% w/w</b>
D. I. water	to 100%
Caltaine <sup>®</sup> C-35	10.0
Caloxamine <sup>®</sup> LO	5.0
Glycerin	0.5
Aloe Vera gel	0.5
Calfoam ES-7-02	20.0
Sodium Chloride	1.0
Preservatives perfume & dye	Q.S

Procedure: Add all ingredients in the order listed with constant mixing. Mix well after each ingredient has been added and then at the end when all ingredients have been added until a clear, smooth, homogenous batch is obtained that is free of lumps and / or particles.

## **Mild, "Natural" Herbal Shower Gel**

<b>Ingredient</b>	<b>% w/w</b>
Distilled Water	to 100%
Disodium cocoamphodiacetate	20.0
Calfoam <sup>®</sup> TLS-40	20.0
Caltaine <sup>®</sup> C-35	20.0
Aloe Vera extract	1.0
Chamomile extract	1.0
Hops extract	1.0
Rosemary extract	1.0
Sodium Chloride	3.0
Citric acid	to pH 5.0
Preservative, perfume & dye	as required

Procedure: Add all ingredients in the order listed with appropriate mixing. Mix well after each ingredient has been added until the batch is smooth, homogenous and is free of lumps or particles. Mix an additional hour after all ingredients have been added or until the batch is clear, smooth, and homogenous. Let stand the batch until the air is out before packaging it.

## **Natural High Active Liquid Laundry Detergent**

<b>Ingredient</b>	<b>% w/w</b>
Water	to 100%
Sodium Citrate	2.0
Polysorbate 20	5.0
Cocamine Ethoxylate (5 mole)	25.0
D'limonene	3.0
Calfoam <sup>®</sup> ES-303	25.0

Procedure: Add all ingredients in the order listed with constant mixing. Mix well after all ingredients have been added until a smooth, homogenous batch results without any lumps or particles.

## **Luxurious Shower Gel Formula**

<b>Ingredient</b>	<b>% w/w</b>
Water	46.5
Polyquaternium-10	0.5
Sodium cocoamphoacetate	15.0
Calfoam <sup>®</sup> ES-702	20.0
Caltaine <sup>®</sup> C-35	15.0
C <sub>12-15</sub> alcohol benzoate	2.5
Citric acid	0.5
Preservative, perfume & dye	as required

Procedure: Heat water to 60<sup>0</sup> C and maintain this temperature. Add all ingredients in the order listed with appropriate mixing. Mix well after each ingredient has been added until the batch is smooth, homogenous and is free of lumps or particles. Cool the batch down to 35<sup>0</sup> C. Add preservative, perfume & dye. Continue cooling to room temperature. Let stand the batch until the air is out before packaging it.